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Review of the scientific achievements and other activities by

Dr Gema Trigós Peral

in relation to the conferment of the post-doctoral degree of Doctor Habilitated

Candidate profile

The candidate is a graduate of the University of Córdoba, Spain, where she obtained a Master's degree in biology in January 2008. She was awarded the doctoral degree at the same University in October 2015. Since July 2014, she has been continuously affiliated with the Museum and Institute of Zoology of the Polish Academy of Sciences, where, since June 2018, she has held the position of adjunct. Since her student years and throughout her entire scientific career, she has worked in the field of myrmecology.

Assessment of the scientific achievement

The candidate submitted two achievements for evaluation: a main achievement and an additional one. She entitled the main achievement "Urban areas: Biotic and abiotic stressors shape ant communities in anthropogenic environments". It consists of four publications. Dr Trigós Peral is the first and corresponding author in all of them.

The first article, from 2020 (*Urban Ecosystems*; IF = 3.005, 70 points), concerns the influence of different types of urban green areas and their management regimes on invertebrate communities, namely ants, spiders, and harvestmen, in the city. As part of this work, 11 sites in Warsaw were studied, belonging to three categories: botanical gardens, public parks, and urban forests. The study compared, among other things, species composition and diversity, as well as differences among types of green areas. It was found that communities differ among types of green areas: botanical gardens and urban forests show higher diversity, whereas parks are more strongly dominated by common and synanthropic species. Moreover, the mode and intensity of management are associated with differences in the structure of these communities. The candidate declared a leading and broad contribution to the work, including conceptualization, acquisition of funding, data collection and analysis, as well as preparation of the

manuscript. Some doubts, however, arise here regarding the issue of funding. The candidate states that she obtained funds for the research, yet the publication itself does not provide information on the source. I was also unable to find, in the documentation, confirmation of the funding mentioned in the Self-Report, namely “Gwiazda 2015” of the Polish Academy of Sciences. In this situation, it must be assumed that the article was produced without dedicated funding.

The second paper, from 2021 (*Biological Invasions*; IF = 3.606, 100 points), concerns the behavioural mechanisms enabling the co-occurrence of two invasive ant species, *Lasius neglectus* and *Linepithema humile*. Laboratory studies were conducted in which direct interactions between individuals of both species were analysed at different numerical ratios. Aggressive and submissive behaviours were recorded, along with their frequency and sequences. It was also tested whether the co-occurrence of populations in nature was associated with changes in the level of aggression. The results show that both species exhibit behavioural plasticity and adjust their competitive strategies to the context of the interaction, especially to numerical advantage. *L. neglectus* ants showed particularly aggressive responses when they were less numerous, whereas *L. humile* ants achieved greater success in interactions when they had a numerical advantage. At the same time, populations that had previously co-occurred showed a reduced level of aggression, suggesting the possibility of limiting costly interspecific interactions. As in the case of the first article, the candidate declares a leading and broad contribution to the work. Here, too, certain doubts arise with regard to the assigned funding and the link between the publication and a seven-month stay at the Doñana Biological Station in 2020–2021. The article was submitted to the journal at the beginning of March 2020, whereas the research had been conducted earlier, in 2016. The publication itself also does not provide information about any funding project. Therefore, as above, it should be assumed that the article was produced without dedicated funding.

The next article, from 2024 (*Science of the Total Environment*; IF = 8.200, 200 points), analyses the influence of urban abiotic stressors, specifically the urban heat island effect and artificial light at night, on the functioning of *Lasius niger* colonies. The study combines field and experimental data, including foraging activity, locomotor traits, and colony growth dynamics. Night-time foraging activity was usually higher in urban than in non-urban environments, which corresponds with the higher night-time temperatures of the former, although the effect depended on the city. In laboratory experiments, both higher temperature and continuous illumination increased activity, although differences among the cities from which the colonies originated were also present. At the colony level, higher temperature accelerated the development of young individuals, but at the same time increased worker mortality. Workers from cities were also slower, less exploratory, and spent more time immobile. Overall, it was shown that urban night-time conditions increase foraging activity, but at the same time are associated with certain costs related to heat stress and changes in behavioural strategies. As in the case of the

previous two articles, the candidate declared a leading and broad contribution to the work. The study is well designed and multi-level, and its implementation was supported by funding from the National Science Centre, namely a *Miniatura* research activity, which is also indicated in the article as the source of funding.

The fourth article, from 2024 (*Myrmecological News*; IF = 3.800, 70 points), investigates nutritional limitations in the urban environment and their influence on the condition of *Lasius niger* queens. Colonies from urban and non-urban areas were tested for their food preferences under controlled conditions by offering three types of diet differing in macronutrient composition: carbohydrates, protein, and fat with protein. Both interest in the food and actual consumption were measured. Fat content was also determined in workers and young queens. The results show that colonies differ in their short-term feeding responses. Non-urban colonies show greater interest in a diet rich in protein and fat, whereas urban colonies, immediately after being collected from the field, consume more carbohydrates. Differences in consumption disappear after one week of maintaining colonies under the same laboratory conditions. Young queens from non-urban areas have higher fat content than urban queens, although this difference is not present in individuals reared in the laboratory or in workers. It therefore seems that the urban environment is associated with possible differences in the availability of nutrients, which affect short-term colony feeding behaviour and the level of energy reserves in the sexual caste. As in the case of the previous articles, the candidate's declared contribution is leading and very broad. The work was supported by funding from the Polish National Agency for Academic Exchange for bilateral exchange with the University of Regensburg, Germany.

In my assessment, the main achievement constitutes a thematically coherent cycle of publications on the urban ecology of ants, published in reputable journals (total IF = 18.611; 440 points in total). According to Google Scholar, as of 12 May 2026, these articles had been cited a total of 102 times, which indicates that they have been noticed by the relevant research community and constitute a substantial contribution to the development of the discipline. At the same time, it must be acknowledged that the achievement was produced with only minor, indirect, and supporting funding. I interpret this as evidence of determination and effective collaboration, although it is regrettable that the candidate did not demonstrate greater effectiveness in obtaining external funding. Perhaps these works could then have had a somewhat broader character and, for example, included more studied parameters or locations, which would certainly have been beneficial given the broadly framed research questions posed by the candidate.

The additional achievement consists of two publications: one co-authored article in *Behavioral Ecology* (IF = 3.087, 140 points, from 2021) and one first-authored article in *Insectes Sociaux* (IF = 1.300, 70 points, from 2023).

The first article concerns how environmental features and colony characteristics influence behavioural variation in the ant *Myrmica rubra*, and whether these differences have consequences for colony productivity. The concept of “personality” is introduced here, understood as repeatable behavioural differences, that is, so-called behavioural syndromes. Several behavioural traits were measured in workers, including aggression, exploration, and locomotor activity, with measurements repeated multiple times for the same individuals. Data on colony size and productivity, meaning the number of offspring of different castes, were also collected. It was shown that behaviour differs among individuals and among colonies in a repeatable way, which indicates the presence of “personality” both at the individual and colony levels. Colony size, in turn, influences the level and variability of behaviour; for example, larger colonies show a higher level of aggression. This means that behavioural variation in ants has a multi-level structure, involving both the individual and the colony, and that the environment acts mainly indirectly by shaping colony characteristics. The candidate is second on the list of co-authors and declares participation in fieldwork, data collection, and preparation of the manuscript.

The second article presents research focused on whether there is a systematic relationship between the behavioural traits of workers and the tasks they perform in the colony, using *Camponotus vagus* as an example. Individually marked workers were followed from the moment of emergence. The tasks they performed over time were recorded, for example brood care, social interactions, and locomotor activity, as well as when they transitioned to work outside the nest. In parallel, a set of behavioural traits was measured, such as aggression and exploration, as well as body size. The results show that, despite being the same age, workers differ both in behaviour and in the tasks performed. Some individuals never leave the nest, whereas others transition to foraging outside the nest at different times in life, which means that age does not fully explain the division of labour. Two main behavioural profiles were identified in the analyses: individuals that were more aggressive and exploratory, and individuals that were less aggressive and more “local” in their behaviour. These profiles are linked to tasks: the first group more often performs tasks associated with activity and interactions, whereas the second group more often engages in brood care. More aggressive and more mobile individuals also transition earlier to the role of forager. In addition, body size and lifespan correlate with some aspects of behaviour and task performance, although these effects are more limited. Individual behavioural differences are therefore linked to the division of labour and its dynamics within the colony, although not all of the studied traits are stable over time. The candidate is the first and corresponding author here, and her contribution is leading and includes fieldwork, data collection and analysis, and preparation of the manuscript.

Both articles were produced as a result of funding obtained by Prof. Witek, the head of the laboratory at the Museum and Institute of Zoology PAS to which the candidate

belongs. In my opinion, these works, in a manner convergent with the main achievement, use ants as a research model in behavioural ecology and were published in reputable disciplinary journals (total IF = 4.387; 210 points in total). They constitute a valuable addition. According to Google Scholar, as of 12 May 2026, the two articles making up the additional achievement had been cited 42 times, which indicates their contribution to the development of the discipline, similarly to the case of the main achievement.

Assessment of scientific, teaching, and organizational activity

In the documentation, the candidate declares slightly over 150 citations and an h-index of 8 based on indexed databases. Currently, in the Scopus database, as of 12 May 2026, the candidate has 36 publications and 263 citations, with an h-index of 11. The publication dynamics indicate several publications per year, most often in journals in the first and second quartiles of their assigned categories. The candidate's publication output consists of first-authored and co-authored works. An increasing citation trend can be observed, and it is worth noting that these citations usually come from outside: 224 citations and an h-index of 10 after excluding self-citations. Overall, these parameters are not outstanding, but it is a fact that Dr Trigosa Peral works on topics that usually reach a rather narrow group of specialists. The candidate evidently collaborates closely within the Institute laboratory; however, in most of her publications, the list of co-authors is long and extends beyond the home institution. The total number of collaborators identified by Scopus is 150, which in my view indicates multidimensional collaboration.

Scientific collaboration appears to be one of the important elements of the candidate's research activity. This is evident both in the main achievement submitted for evaluation, which includes papers prepared with 17 different co-authors, and in the Self-Report, where the candidate describes research collaboration with Polish, Romanian, Spanish, German, and French research institutions. It clearly shows her activity in the international research community and her ability to build scientific networks. This should be regarded as a positive aspect of her record, especially since contemporary biological research often requires teamwork, the exchange of expertise, and access to infrastructure across different institutions. At the same time, such extensive collaboration makes it more difficult to assess the candidate's individual contribution and degree of scientific independence unequivocally. This is particularly relevant because, before obtaining her doctoral degree, the candidate did not publish and did not have her own research funding. In my opinion, it should therefore be recognized that the core of her research activity began at the Museum and Institute of Zoology PAS. It is in this institution that she conducts her scientific activity and publishes, primarily within broad national and international collaboration. While working at the Museum and Institute of Zoology PAS, she completed short study visits at Babeş-Bolyai University in Cluj-Napoca, the University of Regensburg, the Doñana Biological Station – CSIC in Seville, and Sorbonne Paris Nord University in Paris. It should be noted, however, that the

Attachments document only a several-day visit to the Doñana Biological Station, funded by the Office for Foreign Cooperation of the Polish Academy of Sciences, and confirmation of funding from the Polish National Agency for Academic Exchange (NAWA) for bilateral exchange between the Republic of Poland and the Federal Republic of Germany. Even if the remaining visits took place without dedicated funding obtained by the candidate, for example at the invitation of foreign collaborators, it would have been appropriate to include confirmations of participation or opinions from the supervisors of these stays. Despite these reservations, I believe that the candidate demonstrates research activity outside her home institution, particularly at the Doñana Biological Station – CSIC and the University of Regensburg, as well as broad scientific collaboration with other researchers in Poland and abroad.

After obtaining the doctoral degree, apart from NAWA funding, the candidate also obtained funding for a research activity under the *Miniatura* call of the National Science Centre (NCN). Although her participation in several research grants in 2016–2025 deserves attention, particularly in NCN projects, namely *Opus*, *Polonez*, twice *Polonez Bis*, and in a *Biodiversa+* project, her own success in obtaining and leading research projects is low and does not allow one to clearly determine how advanced her abilities are to independently direct the work of research teams or to play a leading role in the implementation of projects. The candidate has also participated in several dozen scientific conferences, with a total of 29 abstracts, including 16 first-authored ones, which should be interpreted as active involvement in the international scientific community. I interpret her involvement as an editor for *Insectes Sociaux* and *Fragmenta Faunistica* similarly. I think it is also worth emphasizing the candidate's activity in supervising students from many different institutions, both in Poland and abroad (12 people in total). These individuals carried out work at institutions such as Cardinal Stefan Wyszyński University in Warsaw, Adam Mickiewicz University in Poznań, the University of Warsaw, the Warsaw University of Life Sciences, as well as abroad, in the Netherlands, Germany, Italy, and Spain. The Self-Report also mentions participation in several bodies evaluating candidates for the doctoral degree, in Spain, Italy, and Belgium. Considering the exclusively research-oriented profile of the institution employing the candidate, this is an extensive range of teaching activities. In addition, she is characterized by high reviewing activity, totalling 76 manuscripts, which deserves recognition, because as an editor I know how difficult it can be to find reviewers. Dr Trigos Peral also participated in the organization of five myrmecological conferences in the years 2019–2025.

The candidate's output also includes several local or popular science publications, written in Polish, English, or Spanish, as well as several interviews. However, the candidate's activity in science outreach and organizational work is relatively limited. Apart from membership in the science outreach team of the Museum and Institute of Zoology PAS, which conducts activities through the Institute's social media, no other organizational activities within the home institution have been documented. Her

outreach activity, although present, also appears to be rather limited in scope. In particular, there is no clearly documented involvement of the candidate in national science-popularization initiatives, such as popular science publications, educational events, or activities addressed to a broader public in Poland. No prizes or scholarships have been reported, either scientific or related to science popularization, that would indicate external recognition of this activity. I also do not find in the documentation any examples of the candidate's cooperation with the social or economic environment. It seems that at least some forms of such cooperation, for example expert opinions, consultations, or myrmecological inventories, could fall within the scope of her expertise. Their absence does not undermine the value of her scientific record, but it does indicate that this area of activity remains less developed.

To summarize, I believe that the above-mentioned achievements of Dr Gema Trigos Peral indicate a very well-defined area of research activity and good metrics, with moderate independence. In my opinion, the candidate publishes effectively and shows activities outside of the home institution, as well as broad collaboration with specialists in Poland and abroad. Dr Trigos Peral's research is original and makes an important contribution to the field. Among the weaker elements of her profile, I include the low success in obtaining her own external funding, which limits independence and makes the implementation of research dependent on resources provided by others. Weaker elements also include limited organizational and outreach activity, especially locally, where it has the greatest potential impact. However, these are not aspects that disqualify the candidate in her efforts to obtain the degree of Doctor Habilitated.

Final conclusion

In accordance with Art. 219 of the Law on Higher Education and Science dated July 20, 2018 (Journal of Laws 2021, item 478, as amended), the degree of Doctor Habilitated may be awarded to a person who: 1) holds the degree of Doctor, 2) has scientific achievements constituting a significant contribution to the development of a given discipline, including at least one cycle of thematically related articles published in scientific journals, and 3) demonstrates significant scientific activity carried out in more than one university or scientific institution, in particular a foreign one. After reviewing the submitted documentation, I conclude that the scientific achievements and other scientific, teaching, and organizational activities of Dr Gema Trigos Peral submitted to me for evaluation meet these requirements. Therefore, **I recommend awarding the candidate the degree of Doctor Habilitated** in the field of exact and natural sciences, in the discipline of biological sciences.

Krzysztof Miler



Signed by / Podpisano przez:

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